Measures of Dispersion for ungrouped Data

By : rraezzz

- Measures of dispersion are important measurements
- Disperison is small if the data set has a small range and vice versa
- Measures of dispersion of a set of data are quantitative measures such as range, interquartile range, variance and standard deviation

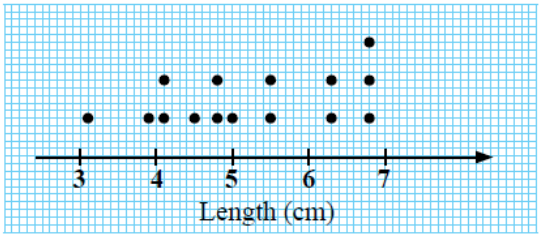
- The distributions of the data are different
- To understand the dispersion of data, the difference between the largest value and the smallest value is taken into consideration
- If the difference between teh values is large, it indicates that the datais widely dispersed and vice versa

(a) The table below shows the masses, in kg, of 20 pupils.

52	60	62	47	55	48	70	67	71	66
48	50	64	51	66	79	62	65	78	72

State the difference in mass, in kg, of the pupils.

(b) The diagram below shows a dot plot of the length, in cm, of a sample of several types of insects.



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A value is a data or results obtained from an observation.

State the difference in size, in cm, of the longest insect and the shortest insect.

Solution:

(a) Largest mass = 79 kg
Smallest mass = 47 kg
Difference in mass = 79 kg – 47 kg
= 32 kg

(b) Length of the longest insect = 6.8 cm
Length of the shortest insect = 3.1 cm
Difference in length = 6.8 cm – 3.1 cm
= 3.7 cm

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Steps to plot a stem-and-leaf plot

- If this data is not organised in the table, then we cannot see the dispersion immediately
- We set the tens digit as the stem and the units digitas the leaf to plot the stem-and-leaf plot for teh given data

Stem	Leaf
2	7 9
3	1 2 4 5 5 6 7 7 8 8 9
4	0 0 1 2 2 2 2 3 4 4 5 6 7 7 7 8 9 9
5	2 2 2 3 4

Key: 2 | 7 means 27 marks

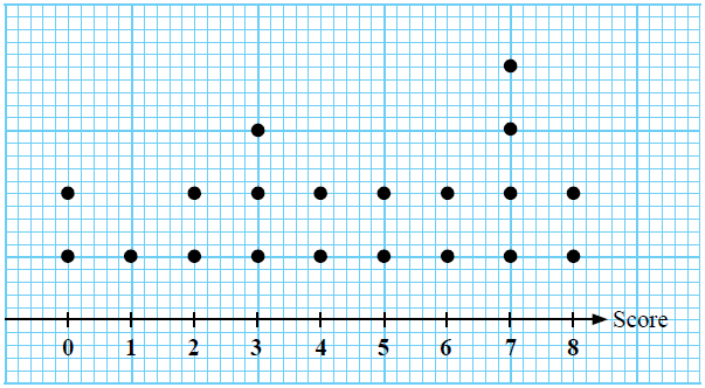
Dot plot

- Is a statistical chart thatcontains points plotted using a uniform scale. Each point represents a value
- In the below dot plot, the highest value is 8, the owest value is 0 and the most pupils get a score of 7

The following data shows the scores obtained by a group of 20 pupils in a Biology quiz.

0	6	4	7	6
2	0	1	7	7
4	5	2	3	8
7	8	3	5	3

The diagram below shows a dot plot for the above data. Each point represents a value.



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The dot plot is appropriate for small data set.

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Measures of Dispersion

- The range of an ungrouped data is the difference between the largest and the smallest value
- This measure shows how data is distributed

Given a set of data 34, 23, 14, 26, 40, 25, 20, determine the range of this set of data.

Solution:

34, 23, 14, 26, 40, 25, 20

Smallest value: 14

Largest value: 40

Range = 40 – 14
= 26

The table below shows the scores obtained by a group of pupils in a Chemistry test.

Score	2	3	4	5	6	7	8
Number of pupils	3	5	6	8	12	7	3

Determine the range of the above data.

Solution:

Smallest value: 2

Largest value: 8

Score	2	3	4	5	6	7	8
Number of pupils	3	5	6	8	12	7	3

Range = 8 – 2
= 6

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Determine the interquartile range of a set of ungrouped data

Determine the interquartile range of each of the following sets of data:

(a) 4, 4, 6, 8, 10, 13, 15, 16, 20, 22, 23

(b) 11, 14, 14, 17, 19, 20, 20, 21, 22

(c) 2.3, 2.5, 2.5, 2.6, 2.8, 2.9, 3.0, 3.2

Solution:

(a) $\underbrace{4 \quad 4}_{2\text{ values}} \quad 6 \quad \underbrace{8 \quad 10}_{2\text{ values}} \quad 13 \quad \underbrace{15 \quad 16}_{2\text{ values}} \quad 20 \quad \underbrace{22 \quad 23}_{2\text{ values}}$

Q_1 | median | Q_3

Interquartile range $= 20 - 6$

$= 14$

Determine the position of the median first.

(b) $\underbrace{11 \quad 14}_{2\text{ values}} \quad \underbrace{14 \quad 17}_{2\text{ values}} \quad 19 \quad \underbrace{20 \quad 20}_{2\text{ values}} \quad \underbrace{21 \quad 22}_{2\text{ values}}$

Q_1 | median | Q_3

$$\text{Interquartile range} = \frac{20 + 21}{2} - \frac{14 + 14}{2}$$

$$= 6.5$$

(c) $\underbrace{2.3 \quad 2.5}_{2\text{ values}} \quad \underbrace{2.5 \quad 2.6}_{2\text{ values}} \quad \underbrace{2.8 \quad 2.9}_{2\text{ values}} \quad \underbrace{3.0 \quad 3.2}_{2\text{ values}}$

Q_1 | median | Q_3

$$\text{Interquartile range} = \frac{2.9 + 3.0}{2} - \frac{2.5 + 2.5}{2}$$

$$= 0.45$$

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Variance and standard deviation for a set of ungrouped data

$$\sigma^2 = \frac{\Sigma(x-\bar{x})^2}{N} \quad \text{or} \quad \sigma^2 = \frac{\Sigma x^2}{N} - \bar{x}^2$$

$$\text{Standard deviation, } \sigma = \sqrt{\frac{\Sigma(x-\bar{x})^2}{N}} \quad \text{or} \quad \sigma = \sqrt{\frac{\Sigma x^2}{N} - \bar{x}^2}$$

Example 8

Determine the standard deviation of the set of data 5, 7, 8, 8, 10, 13, 15, 16, 16, 20.

Solution:

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σ^2 = variance
σ = standard deviation

$$\text{Mean, } \bar{x} = \frac{5+7+8+8+10+13+15+16+16+20}{10}$$
$$= 11.8$$

$$\text{Variance, } \sigma^2 = \frac{5^2+7^2+8^2+8^2+10^2+13^2+15^2+16^2+16^2+20^2}{10} - 11.8^2$$
$$= 21.56$$

$$\text{Standard deviation, } \sigma = \sqrt{21.56}$$
$$= 4.643$$

Example 9

The table below shows the number of books read by a group of pupils in a particular month.

Number of books	0	1	2	3	4
Number of pupils	3	5	8	2	2

Calculate the variance and standard deviation for the number of books read.

Solution:

$$\text{Mean, } \bar{x} = \frac{3(0)+5(1)+8(2)+2(3)+2(4)}{3+5+8+2+2}$$
$$= 1.75$$

$$\text{Variance, } \sigma^2 = \frac{3(0-1.75)^2+5(1-1.75)^2+8(2-1.75)^2+2(3-1.75)^2+2(4-1.75)^2}{20}$$
$$= 1.2875$$

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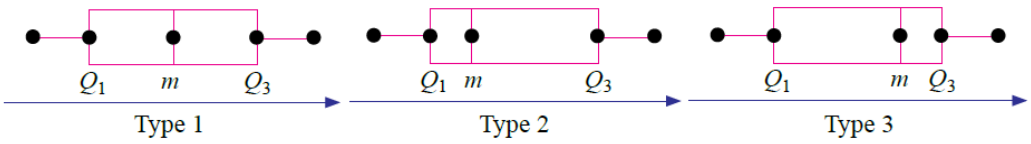
Box plot

- ✓ A way of showing the distribution of a set of data based on five values, namely the minimum value, first quartile, median, third quartile and the maximum value of the set of data
- ✓ Often used to analyse a large number of data
- ✓ Can show whether the set of data is symmetric about the median

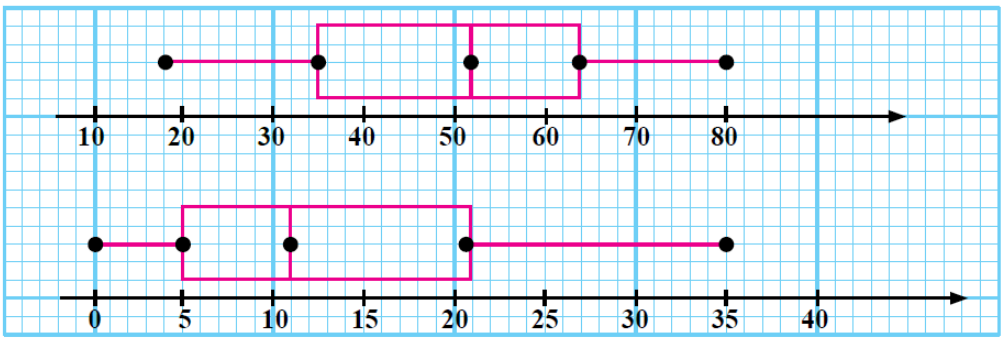
Some of the types of box plots are as follows.



Two box plots are given below.

(a)

(b)



For each box plot, state

(i) the median. (ii) the first quartile. (iii) the third quartile.
(iv) the interquartile range. (v) the minimum value. (vi) the maximum value.
(vii) the range.

Solution:

(a) (i) median = 52
(ii) first quartile = 35
(iii) third quartile = 64
(iv) interquartile range = 29
(v) minimum value = 18
(vi) maximum value = 80
(vii) range = 62

(b) (i) median = 11
(ii) first quartile = 5
(iii) third quartile = 21
(iv) interquartile range = 16
(v) minimum value = 0
(vi) maximum value = 35
(vii) range = 35